

ANOTHER GALL THAT SECRETES HONEYDEW.

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In his paper on "Galls that secrete honeydew," in the October, 1924, number of the BULLETIN, Dr. Bequaert mentions no case either in America or Europe in which such a secretion is of any particular economic interest. Dr. E. F. Phillips, of Cornell University, to whom I am indebted for much information, writes that "in the beekeeping literature there are a number of records (see *Am. Bee Jour.*, 63: 561) of galls furnishing such secretions, but these records seem to be much like those in the entomological literature, merely records of fact without discussion of importance."

Just recently Mr. H. J. Clay, of the Bureau of Agricultural Economics, has brought to my attention an instance that seems to be of sufficient interest to be recorded. A volunteer collaborator in his department, Mr. A. W. Gambs, a beekeeper at Cottonwood, Shasta Co., California, had sent in for determination some immature oak galls with the statement that they secrete honeydew in such quantities in the fall that his bees store up 30 to 40 pounds of honey per hive from this source. Further correspondence resulted in another collection of galls on December 7, some weeks after the fall rains had begun, but by this time the galls had matured and the adults had emerged. The galls seem to be those of *Disholcaspis eldoradensis* Beut. and are produced on twigs of *Quercus lobata* Nee, known locally as the "river bottom" oak. The galls are somewhat depressed and slightly elongated bullets in clusters along the twigs. They have burst out of cracks in the bark along the internodes, remaining broadly attached, the lower half tan-colored and somewhat polished, the upper darker and deeply fissured, and it is this rugose surface which secretes honeydew during the early stages in the growth of the gall.

Mr. Gambs writes: "These galls are much more plentiful in a season following a mild winter or a dry summer than other seasons. They are on the new growth of wood. They show up here August 10 to 20, growing slowly at first, then when the larva gets a start the gall puffs up, in two or three days breaks through the bark and will yield for several days. Then another will come on the same twig farther out, and so on. The yield continues until

the early rains late in October or November. The galls do not occur on all trees, but one large tree to my personal knowledge has yielded for eleven years, while other trees on the same soil and at the same distance from the river, so that subirrigation would be the same, do not yield at all. The flow is best when the season is driest. In a wet season, when the late honey flow is on from the star thistle and blue curl, only now and then will a colony of bees work on oaks. The yield was so heavy this year that there were not half enough bees to care for it. Whole trees would look greasy, and when dry the leaves would look slick, the edges white when broken. I have never noticed any yield of honeydew from galls on the leaves of oaks, but we get some honeydew honey from a plant louse on the leaves of a live oak.

"The economic value of honeydew from this source is that it comes so late in the fall as November 1, and this encourages the bees to raise large quantities of late brood and leaves our bees here in the best of condition for early queen-raising and to supply package bees to northern beekeepers to make up their winter losses. As this is the most northern point in California where early queens and bees can be raised, honey from this source is as good as better quality honey for bee feed. It is much better for winter stores than honeydew honey from aphids on willows farther south."

Mr. Gambs has a bee range 70 miles south, in star thistle pasture, whose honey flow begins late in July and is over in September. This star thistle honey can all be put on the market and his bees then have all of late September and October to accumulate winter stores from the oak galls, while other bees not so favorably situated have little to work on in October. As his climate is such that his bees are never more than 10 days without a flight in winter, he is able to winter successfully on this bee food, and in recent years finds it more profitable to utilize these unique local conditions to produce queens and package bees, for which the market is good in March, April and May, rather than to run for spring honey. The prolonged late flow not only favors the rearing of brood but enables the bees properly to prepare their "winter nest" inside the hive for the outdoor wintering.

The sample comb of honey made from these oak galls is lighter in color than aphid honeydew honeys, and Mr. Wm. F. Kunke, of the Bureau of Chemistry, finds that it contains 18 per cent. moisture, 0.42 per cent. ash, and gives a levorotatory polariscope read-

ing of — 15.2, allying it with the true floral product rather than with the dextrorotatory honeys produced from the honeydew of aphids.

The writer has seen these immature galls secreting honeydew on August 15 at Placerville on this same species of oak, and noted the mature galls on this oak at Newhall, Ojai, Lebec, Visalia, Kaweah, Stockton, Santa Margarita, Paso Robles, Los Gatos, Palo Alto, Santa Rosa, St. Helena, Calistoga, Ukiah, Bartlett Springs, Lakeport, Chico and Red Bluff.

A similar but undescribed twig gall was observed by the writer on the scrub Kaweah oak in Sequoia National Park, just above Cedar Creek checking station on the road to Giant Forest. These galls were just bursting out through the bark on September 8, 1922, forming clusters for several inches along the twigs and secreting honeydew so copiously that it dripped down the stem and on to the leaves and ground below, and in the hot sun it became very sticky, as did one's hands in gathering a quantity of the galls for rearing. On the preserved galls some of it evaporated down to a hard white amorphous solid which gave a dextrorotatory polariscope reading and a calculated dextrose sugar content of 45 per cent. When tested with Fehling's solution it gave no characteristic reduction, confirming the single test reported by Dr. Bequaert. Mr. Kunke adds, however, that "on heating, considerable free ammonia was given off, indicating that an ammonium compound is present in appreciable amount." The significance of this is not clear unless some protein of plant or animal origin was included in the sample.

Among beekeepers at least, the term "honeydew" is applied to sweetish material from two sources, namely, the excretion of certain Hemiptera such as scale insects, leaf hoppers and aphids, and the exudations from the extra-floral nectaries of plants, the latter being the less common.

Aphid honeydews yield a honey characterized by right-handed polarization, deficiency in invert sugar, abnormally high ash content, and a high proportion of gums and resins which make it dark in color. It yields more waste material than any other bee food, and as this waste can be voided from the intestine only when bees are in flight such food is suitable for wintering only in a mild region where the weather is such that bees can fly at least once in every two or three weeks. On such food, if the winters are severe or where no flight is possible for six weeks or two

months, bees perish of dysentery. The bad effects of such winter stores seem to be well understood by beekeepers. Mr. Gambs writes that they get some late honeydew honey from a plant louse on willows. Still, when frequent flights are possible bees can be wintered successfully on it, for Dr. Phillips says that "in the San Joaquin valley there are a number of beekeepers who regularly move their bees to the swampy lands each fall to enable them to fill up on insect honeydew for winter." This honeydew is secreted mostly in the daytime, nearly ceasing at night. Such secretions of aphids often drip from the trees to walks and ground, and in unusual seasons furnish enough material to keep bees busy for weeks. In Hawaii large quantities of honey are produced from the honeydew of insects on sugar cane, and as it is dextrorotatory it does not conform to the U. S. food standards and can not be sold as honey. It is imported by the carload and used by bakers in the production of honey wafers and candy, retaining moisture and the honey flavor after cooking better than does pure honey.

Extra-floral nectaries are normal structures on many plants. Bonnier determined that their exudations occurred mostly at night, reaching a maximum at sunrise, the favoring conditions being darkness, increased humidity and cool nights alternating with hot dry days. They are far less abundant in tropical and temperate climates than they are in higher latitudes, and at high altitudes many plants excrete freely from their leaves when the same species furnishes no such secretion nearer sea level. As an example of the last statement Dr. Phillips cites the case of the "quaking aspen which at high altitudes secretes abundantly from one to three glands on the leaves, so that sometimes the secretion is so abundant as to soak one to the skin in going through a tract covered by this species." Cotton has extra-floral nectaries both on the involucre bracts and on the under side of the leaves, the latter being most active when the leaf reaches maturity and prolonging the honey flow from July until after the first frosts.

Few analyses of secretions from extra-floral nectaries are available, but they are said to be higher in ash and in dextrins than most floral nectars. In them Bonnier found also cane sugar, mannite, glucose, gums and tannin, and although they vary much in different plants he concludes that in a general way these plant honeydews are different from the honeydews of aphid origin, their composition being more like that of floral nectar.

The honey-producing glands on galls seem to consist histologically of tissues produced normally on other parts of the plant and here called into being by the plant in response to the stimulus of the gall-maker. They might be called artificial extra-floral nectaries, and, although on an abnormal plant structure, their secretion is a pure plant product. How closely allied chemically it is to the nectar or the secretion of other extra-floral nectaries on the same plant we do not know, for no chemical work other than the two tests with Fehling's solution mentioned above seems to have been done.

In spite of its high ash content this honey, being levorotatory, is closely allied to the true honeys and much better in quality than the aphid honeydew honeys. It seems unfortunate that the term honeydew has been applied to the extra-floral excretions of plants as well as to the apparently similar excretions of insects, which are quite different chemically, and the resulting honeys from which are quite different.

Food plant of *Corythucha marmorata* Uhler. This species is frequently found on the underside of the basal leaves, near the ground, of a species of golden rod (*Solidago*), growing by roadsides. They are to be seen there in great numbers in all stages, the leaves being much bleached by their activities. This is noted by Parshley in *Hemiptera of Connecticut*, p. 702. This species and *C. ciliata* Say are locally the most abundant of the genus about White Plains.—J. R. DE LA TORRE-BUENO, White Plains, N. Y.